Associations Between Maternal Obesity and Race, with Obstetric Anal Sphincter Injury: A Retrospective Cohort Study

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Abstract

This retrospective cohort study examined associations between maternal body mass index (BMI), race, and obstetric anal sphincter injury (OASI) (3rd/4th degree perineal lacerations). Obstetric anal sphincter injury may lead to significant maternal morbidity, and a more thorough understanding of risk factors for this complication may guide providers in patient counseling and procedures such as episiotomy or operative vaginal delivery. Vaginal deliveries performed at Kapi'olani Medical Center for Women and Children from 2008-2015 were included. Maternal body mass index at delivery was used and OASIs identified through International Classification of Diseases codes. Demographic/clinical variables were summarized through descriptive statistics. Adjusted odds ratios were calculated using multiple logistic regression. Of the 25,594 deliveries included, 1,198 (4.7%) involved an OASI. OASI prevalence differed by BMI (P < .0001). The prevalence was highest in women with BMI < 30 kg/m^2 (5.3%) and then decreased as BMI increased with women with BMI ≥ 50 demonstrating the lowest prevalence (1.7%). Compared to women with BMI < 30 kg/m^2, women with BMI > 50 kg/m^2 had a lower odds of OASI (OR 0.31 [95%CI 0.11 – 0.83]), which persisted after adjustment (aOR 0.28 [95%CI 0.08 – 0.96]). OASI also differed by race (P < .0001), with Native Hawaiian and other Pacific Islanders (NHOPI) demonstrating the lowest prevalence (3.0%) and Asians the highest (5.6%). After adjustment, compared to White women, NHOPI women had lower OASI prevalence that met the borderline of statistical significance (aOR 0.79 [95%CI 0.62 – 1.01]), while Asian women continued to demonstrate increased prevalence (aOR 1.50 [95% CI 1.22 – 1.85]). We conclude that obese women, including those with BMI ≥ 50 kg/m^2, have lower OASI prevalence. Race is also a significant factor, with Asians almost double the prevalence of NHOPIs. These findings contribute to evidence-based, individualized patient counseling on OASI.

Keywords

Body Mass Index; Hawaii; Lacerations: Risk Factors

Abbreviations

OASI = obstetric anal sphincter injury
BMI = body mass index

Introduction

Obstetric anal sphincter injury (OASI), which includes third and fourth degree perineal lacerations, is the most common cause of anal incontinence in women.[1] Even 5 to 10 years after delivery women with a history of an OASI are more than twice as likely to report anal incontinence and increased impact of this incontinence on quality of life.[2] Other sequelae include pain, infection, dyspareunia, and sexual dysfunction.[3] In addition, elective cesarean for the subsequent delivery has been reported in nearly 25% of women with a history of an OASI. Of those who do deliver vaginally, the risk of recurrent OASI is increased five-fold compared to those without this history.[4]

Rates of OASI are estimated at 6% for primiparous women.[5] Risk factors for OASI are well-described and include operative vaginal delivery (forceps or vacuum-assisted), increased birthweight, primiparity, episiotomy, and occiput-posterior position.[5-7] Less understood is the relationship between OASI and maternal obesity, a condition of escalating frequency.[8] Studies have found increased,[9] unchanged,[10-12] or decreased[13,14] rates of OASI in obese women. In addition, there is little information on OASI in patients with the greatest degree of obesity, body mass index (BMI) ≥ 50 kg/m^2, which is the fastest growing class of obesity in the United States (US).[15] It is conceivable that this population has a unique risk profile compared to obese patients with lesser BMIs.

Race has also been described as a risk factor for OASI, with Asian women in particular at increased risk.[16-18] However, there is little data on OASI in Native Hawaiian and other Pacific Islander (NHOPI) women. While this racial group currently comprises less than 1% of the US population, it is an increasing demographic that is expected to double by 2060.[19]

A more thorough understanding of the risk factors for OASI can assist providers in patient counseling, particularly when operative vaginal delivery and/or episiotomy is under consideration. Our aims were to explore the associations between OASI, maternal BMI, and maternal race with a focus on (a) BMI ≥ 50 kg/m2, and (b) NHOPI race.

Materials and Methods

This retrospective cohort study included all women who underwent vaginal delivery at Kapi'olani Medical Center for Women and Children (Honolulu, Hawai'i, USA), a tertiary care teaching maternity hospital, between November 2008 and June 2015.

Obstetrical anal sphincter injuries were identified through International Classification Diagnosis, Ninth Revision, codes (ICD-9 664.21 and 664.31). Maternal BMI was calculated from weight and height recorded at the delivery admission and categorized by increments of 10 kg/m^2. As delivery BMI was used, which includes gestational weight gain, the nonpregnant BMI categories of underweight, normal weight, overweight, and obese were avoided. Women with recorded weight < 500 or > 10,000 ounces or height < 32 or > 100 inches were excluded due to likely errors in data input.

Maternal race was self-reported and recorded by a nurse upon admission. Race was grouped according to United States Census Bureau categories of White, Black, American Indian or Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander (NHOPI).[20] If more than one race was reported the woman was classified as multiracial with the exception of part Native Hawaiian women, who were classified as NHOPI.

Data were summarized by descriptive statistics: means and standard deviations for continuous variables and frequencies and percentages for categorical variables. OASI prevalence was compared using the student t-test and Wilcoxon test for normally and non-normally distributed data, respectively. The Fisher's exact or chi-square test was used to compare OASI status for categorical data. We calculated both odds ratios (ORs) and adjusted ORs (aORs) using multivariate logistic regression models (simple binary logit model). For BMI, < 30 kg/m^2 was used as the reference group, and for maternal race, White race was used. Confounding variables included in the model were those previously associated with OASI and included maternal race, birthweight, episiotomy, fetal head position, operative vaginal delivery, parity, and shoulder dystocia.[5,6] To further explore the relationship between OASI and BMI, we also created a model including only age, race, and parity to account for potential relationships between obesity and the other risk factors. All statistical analyses were performed using SAS software version 9.3 (SAS Institute Inc., Cary, NC). A *P*-value of < .05 was considered statistically significant. This study received IRB exemption from the Hawai'i Pacific Health Research Institute.

Results

Within the study interval 25,594 vaginal deliveries occurred, which included 1,198 OASIs (4.7%). BMI was available for 23,198 (90.6%) and race available for 24,481 (95.7%) of the deliveries. Of these deliveries, complete information was available for 20,605 women (80.5%), who were included in the multivariable analyses. Demographic and clinical data by OASI occurrence are described in Table 1. OASI increased with previously reported risk factors, including primiparity, episiotomy, operative vaginal delivery, occiput posterior position, and shoulder dystocia (*P*< .0001 for all). The overall episiotomy rate was 7.8%, which included 1,829 midline and 175 mediolateral episiotomies. The operative vaginal delivery rate was 7.9%, which included 934 forceps-assisted deliveries and 1074 vacuum-assisted deliveries. The majority of demographic/clinical variables were significantly different across different BMI (Table 2a) and race (Table 2b) categories. Notably, midline episiotomies and operative vaginal deliveries were most common in women with BMI < 30 kg/m^2 and then decreased as BMI increased.

OASI incidence differed significantly by BMI category (*P*< .0001), as shown in Table 1. OASI was most common in women with a BMI < 30 kg/m^2 (5.3%), then decreased as the BMI category increased to a rate of 1.7% in women with a BMI of ≥ 50 kg/m^2. The unadjusted and adjusted odds of OASI by BMI are shown in Table 3a. Women with BMI ≥ 50 kg/m^2 had a decreased odds of OASI (OR 0.31 [95%CI 0.11 – 0.83]) compared to women with a BMI < 30, which remained similar after adjusting for confounders (aOR 0.28 [95%CI 0.08 – 0.96]). Women with BMI of 30-39.9 kg/m^2 also had decreased odds of OASI (OR 0.78 [95%CI 0.68 – 0.89]), as did women with BMI 40-49.9 kg/m^2 (OR 0.73 [95%CI 0.57 – 0.93]). However, after adjusting for confounders OASI rates remained significantly lower only for women with BMI ≥ 50 kg/m^2. There were no differences between BMI groups when adjusting for maternal age, race, and parity only.

Asian women comprised the majority of the cohort (N=12,973, 50.7%), followed by NHOPI (n = 7,768, 30.4%), White (n = 3,263, 12.8%), Black (n = 230, 0.9%), multiracial non-Hawaiian (n = 187, 1.0%), and American Indian and Alaskan Native (n = 60, 0.2%) women. Maternal race was significantly associated with OASI (*P*< .0001), with NHOPI and Black women with the lowest incidence (3.0%) and Asian women with the highest (5.6%) (Table 1). NHOPI women had lower odds of OASI compared to White women (OR 0.63 [95%CI 0.51 – 0.77]), which met the borderline of statistical significance after adjusting for confounders (aOR 0.79 [95% CI 0.62 – 1.01]) (Table 3b). Asian women demonstrated increased odds of OASI compared to White women (OR 1.23 [95% CI 1.03 – 1.48]), which remained significant after adjustment (aOR 1.50 [95% CI 1.22 – 1.85]) (Table 3b).

Discussion

This study indicates lower OASI incidence in maternal obesity, including those with the greatest degree of obesity (BMI ≥ 50 kg/m^2). Our findings suggest that the decreased OASI risk in obese women reported in prior studies extends to those with the greatest degree of obesity. In our cohort, in fact, decreased OASI incidence remained significant only for the BMI ≥ 50 kg/m2 group after adjusting for risk factors. For women with lesser degrees of obesity associated confounders may have a greater influence on the decreased OASI incidence observed. Interestingly, the interventional risk factors of episiotomy and operative vaginal delivery were highest among those with BMI < 30 kg/m^2 and lowest with BMI ≥ 50 kg/m^2. The underlying reasons for these findings and the role it may play in the relationship between OASI and BMI deserves further study.

While many prior studies have used BMI at the first antenatal visit,[12-14] we used BMI at the end of pregnancy. The difference in timing expands current knowledge on the association between BMI and OASI, and provides an opportunity for future work comparing the predictive value of BMI at different gestational ages.

We also found NHOPI women to be at lower odds for OASI compared to white women, likely secondary to nonracial factors as there was no statistical difference after adjustment for confounders. de Silva, et al, did not find differences in OASI between Asian and Pacific Islander subgroups, but included a cohort with a 41% episiotomy rate.[21] Higher episiotomy rates are common in studies conducted prior to adoption of the restricted episiotomy use that is prevalent in modern obstetrical practice. Given the well-known association between episiotomy and OASI, a high episiotomy rate could conceivably affect the relationship between race and OASI. Our data also support previous findings of increased rates of OASI in Asian women. As with BMI, the etiology behind the associations between race

Table 1. Demographic and Clinical Data by Obstetrical Anal Sphincter Injury, n (% of row) unless specified			
Variable	**Obstetric Anal Sphincter Injury n = 1,198***	**No Obstetric Anal Sphincter Injury n = 24,396***	***P*-value**
Age, y (mean [SD])	28.2 (6.1)	28.0 (6.3)	.33
BMI, kg/m²	n = 1,098	n = 22,100	<.0001
< 30.0	630 (5.3)	11,171 (94.7)	
30.0 – 39.9	391 (4.2)	8,913 (95.8)	
40.0 – 49.9	73 (3.9)	1,784 (96.1)	
> 50.0	4 (1.7)	232 (98.3)	
Maternal Race	n = 1,132	n = 23,349	<.0001
Asian	732 (5.6)	12,241 (94.4)	
NHOPI	231 (3.0)	7,537 (97.0)	
White	151 (4.6)	3,112 (95.4)	
Black	7 (3.0)	223 (97.0)	
AI/AN	2 (3.3)	58 (96.7)	
Multiracial (non-Hawaiian)	9 (4.8)	178 (95.2)	
Birthweight, g (mean [SD])	3,310 (470.5)	3,144 (584.8)	<.0001
Parity	n = 1,116	n = 23,104	<.0001
Primiparity	602 (9.5)	5,724 (90.5)	
Multiparity	514 (2.9)	17,380 (97.1)	
Episiotomy			<.0001
Midline	270 (14.8)	1,559 (85.2)	
Mediolateral	19 (10.9)	156 (89.1)	
None	909 (3.9)	22,681 (96.2)	
Operative Vaginal Delivery			<.0001
Forceps	245 (26.3)	689 (73.8)	
Vacuum	203 (19.0)	871 (81.0)	
Nonoperative	749 (3.1)	22,835 (96.9)	
Fetal head position	n = 1,140	n = 22,707	<.0001
Occiput anterior	1,001 (4.5)	21,492 (95.6)	
Occiput posterior	115 (11.6)	879 (88.4)	
Occiput transverse	20 (7.3)	256 (92.8)	
Other	4 (4.8)	80 (95.2)	
Shoulder Dystocia			<.0001
Yes	36 (9.9)	327 (90.1)	
No	1,162 (4.6)	24,069 (95.4)	

*Unless specified. NHOPI - Native Hawaiian and other Pacific Islander. AI/AN - American Indian or Alaskan Native

Table 2A. Demographic and Clinical Variables by Maternal Body Mass Index					
Variable n (% of column), unless specified	**Maternal Body Mass Index (kg/m²)**				***P*-value**
	< 30.0	30.0 – 39.9	40.0 – 49.9	≥ 50.0	
Maternal Race, n (% of row)					
Asian	7,210 (61.3)	4,052 (34.5)	448 (3.8)	46 (0.4)	<.0001
NHOPI	2,195 (31.1)	3,536 (50.1)	1,155 (16.4)	166 (2.4)	
White	1,695 (56.9)	1,125 (37.8)	146 (4.9)	13 (0.4)	
Black	96 (46.2)	87 (41.8)	22 (10.6)	3 (1.4)	
AI/AN*	22 (46.8)	21 (44.7)	4 (8.5)	0 (0.0)	
Multiracial non-Hawaiian	85 (50.0)	67 (39.4)	15 (8.8)	3 (1.8)	
Birthweight g, mean (SD)	3,054 (551)	3,241 (569)	3,361 (615)	3,403 (613)	<.0001
Episiotomy					
Midline	1,012 (8.6)	580 (6.2)	80 (4.3)	5 (2.1)	<.0001
Mediolateral	102 (0.9)	58 (0.6)	3 (0.2)	0 (0.0)	
None	10,687 (90.6)	8,666 (93.1)	1,774 (95.5)	231 (97.9)	
Fetal head position					
Occiput anterior	10,452 (95.0)	8,188 (93.9)	1,648 (95.7)	207 (95.4)	.0026
Occiput posterior	418 (3.8)	420 (4.8)	59 (3.4)	10 (4.6)	
Occiput transverse	128 (1.2)	111 (1.3)	15 (0.9)	0 (0.0)	
Operative vaginal delivery					
Forceps	464 (3.9)	321 (3.5)	59 (3.2)	10 (4.2)	<.0001
Vacuum	578 (4.9)	360 (3.9)	42 (2.3)	5 (2.1)	
Nonoperative	10,757 (91.2)	8,623 (92.6)	1,756 (94.5)	221 (93.6)	
Primiparity	3,467 (31.2)	2,033 (22.8)	345 (19.2)	41 (18.0)	<.0001
Shoulder dystocia	100 (0.8)	167 (1.8)	63 (3.4)	5 (2.1)	<.0001

NHOPI – Native Hawaiian and other Pacific Islander. AI/AN - American Indian/Alaskan Native.

Table 2B. Demographic and Clinical Variables by Maternal Race							
Variable n (% of column), unless specified	**Maternal Race**						***P*-value**
	Asian	**NHOPI**	**White**	**Black**	**AI/AN**	**MuR**	
Birthweight g, mean (SD)	3,086 (541)	3,238 (596)	3,230 (624)	3,073 (684)	3,295 (465)	3,102 (563)	<.0001
Episiotomy							
Midline	1,096 (8.4)	367 (4.7)	253 (7.7)	15 (6.5)	3 (5.0)	8 (4.3)	<.0001
Mediolateral	131 (1.0)	23 (0.3)	12 (0.4)	1 (0.4)	0 (0.0)	0 (0.0)	
None	11,746 (90.5)	7,378 (95.0)	2,998 (91.9)	214 (93.0)	57 (95.0)	179 (95.7)	
Fetal head position							
Occiput anterior	11,384 (94.4)	6,875 (95.3)	2,852 (94.3)	195 (91.1)	50 (94.3)	164 (94.8)	0.02
Occiput posterior	516 (4.3)	271 (3.7)	137 (4.5)	19 (8.9)	2 (3.8)	8 (4.6)	
Occiput transverse	162 (1.3)	68 (0.9)	35 (1.2)	0 (0.0)	1 (1.9)	1 (0.6)	
Operative vaginal delivery							
Forceps	564 (4.3)	222 (2.9)	104 (3.2)	5 (2.2)	3 (5.0)	4 (2.1)	<.0001
Vacuum	661 (5.1)	218 (2.8)	116 (3.6)	8 (3.5)	4 (6.7)	10 (5.3)	
Nonoperative	11,746 (90.6)	7,328 (94.3)	3,043 (93.2)	217 (94.3)	53 (88.3)	173 (92.5)	
Primiparity	3,313 (26.8)	1491 (20.0)	1,059 (35.0)	73 (34.8)	22 (40.7)	65 (37.8)	<.0001
Shoulder dystocia	198 (1.5)	105 (1.4)	42 (1.3)	1 (0.4)	0 (0.0)	1 (0.5)	.39

NHOPI – Native Hawaiian and other Pacific Islander. AI/AN - American Indian/Alaskan Native.

Table 3A: Odds Ratios (ORs) and Adjusted Odds Ratios (aORs) for Obstetric Anal Sphincter Injury for Maternal Body Mass Index

Maternal Body Mass Index (kg/m^2)	OR (95% CI)	aOR (95% CI) *
< 30.0	Reference	Reference
30.0 – 39.9	0.78 (0.68 – 0.89)	0.87 (0.71 – 1.01)
40.0 – 49.9	0.73 (0.57 – 0.93)	1.00 (0.75 – 1.33)
≥ 50.0	0.31 (0.11 – 0.83)	0.28 (0.08 - 0.96)

*Adjusted for maternal race, birthweight, episiotomy, fetal head position, operative vaginal delivery, parity, shoulder dystocia.

Table 3B. Odds Ratios (ORs) and Adjusted Odds Ratios (aORs) for Obstetric Anal Sphincter Injury for Maternal Race

Maternal Race	OR (95% CI)	aOR (95% CI) *
White	Reference	Reference
NHOPI	0.63 (0.51-0.78)	0.79 (0.62-1.01)
Asian	1.23 (1.03-1.48)	1.50 (1.22-1.85)
Black	0.65 (0.30-1.40)	0.64 (0.25-1.64)
AI/AN	0.71 (0.17-2.94)	0.78 (0.17-3.57)
Multiracial (non-Hawaiian)	1.04 (0.50-2.08)	1.09 (0.46-2.56)

*Adjusted for body mass index, birthweight, episiotomy, fetal head position, operative vaginal delivery, parity, shoulder dystocia. NHOPI - Native Hawaiian and other Pacific Islander. AI/AN - American Indian or Alaskan Native.

and OASI are unclear. Perineal body length in the first stage of labor was not found to differ by race,[22] but there is little other anatomical or physiological investigation into potential explanations for these associations.

Strengths of this study include a large cohort exposed to modern obstetrical practice, including restrictive episiotomy use. While the study was limited to a single institution, approximately 125 providers practice within this institution, reflecting a broad scope of practice. A limitation of this study was the inability to further subdivide NHOPI and Asian women into the many subgroups within these races. Further classification is particularly relevant in Hawai'i, where providers serve many women from a large number of these racial subgroups. Another limitation is potential variation in how women were asked to report race, as this data was obtained by a large number of health care providers outside of a research protocol. In addition, the identification of OASI relied on clinical assessment, which misses occult sphincter injuries at the time of repair. However, clinical assessment is currently the most common method of OASI diagnosis and has been used to associate OASI with adverse clinical outcomes.

While maternal race is a nonmodifiable risk factor and patients are counseled against obesity, our findings can assist providers as they risk-stratify patients for OASI. Knowledge of such risk factors can be incorporated into patient counseling and clinical decision-making regarding interventions known to increase the risk of OASI, such as episiotomy or operative vaginal delivery. A more thorough understanding of risk factors can also guide future research into anatomic and physiologic factors affecting the risk of OASI.

Conflict of Interest

None of the authors identify any conflict of interest.

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